

# MU-SPIN


Minority University-SPace Interdisciplinary Network



Advancing Minority Scholastic  
Programs to Benefit NASA's Mission

<http://muspin.gsfc.nasa.gov>

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**James Harrington,**  
**MU-SPIN Project Manager**

## Introduction

To help train the next generation of NASA's minority scientists and engineers, NASA created the Minority-University S**P**ace Interdisciplinary Network (MU-SPIN). MU-SPIN was started in 1990 by NASA's Office of Equal Opportunity Programs and has remained a highly effective program as it has grown and evolved over the past decade. The program was established to serve America's Historically Black Colleges and Universities (HBCUs) and Other Minority Universities (OMUs). OMUs include Hispanic Serving Institutes and Tribal Colleges and Universities.

The first step for MU-SPIN was to help provide schools and campuses with network infrastructure. MU-SPIN recognized the need to provide access to the Internet—the world of electronic information exchange and the sharing of educational resources. MU-SPIN helped minority schools buy and even build their own computers for the classroom.

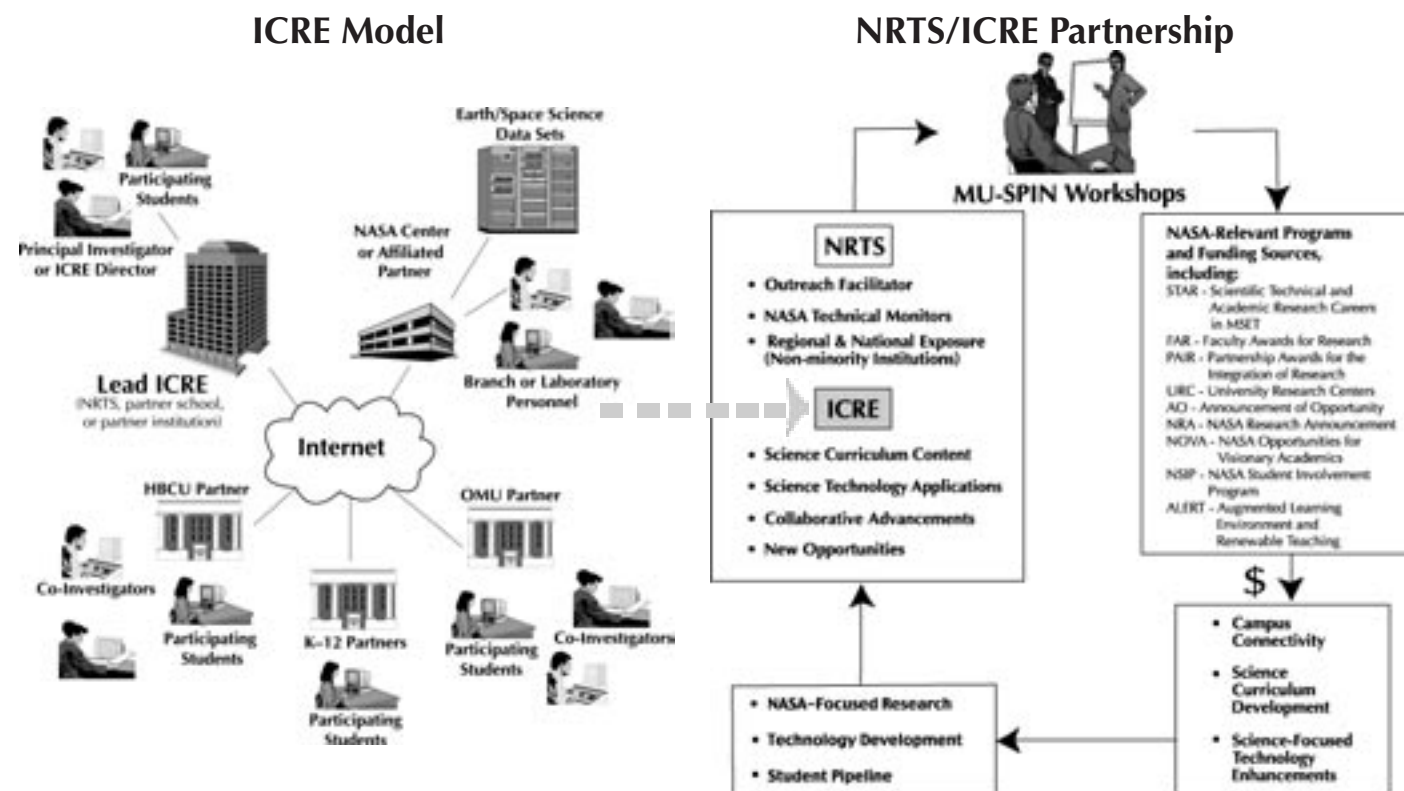
In MU-SPIN's next phase, the program established regional hubs to help extend its program to a larger minority community. To do this, NASA established Network Resources and Training Sites (NRTSs). With the NRTSs, the program expanded, targeting students from kindergarten through college, faculty, administrators, and community members.

With the infrastructure and regional hubs in place, MU-SPIN established Expert Institutes. These institutes serve as focus areas to foster scientific curriculum development and research with the goal of increasing participation in NASA-related sciences.

To further expand its reach, MU-SPIN created the Institute for Collaborative Research and Education (ICRE) model. This approach facilitates leadership by current MU-SPIN partners and encourages the involvement of new partners.

## The ICRE Concept

MU-SPIN promotes NASA science and technology in minority schools through the Institutes for Collaborative Research and Education (ICREs) in cooperation with the Network Resources and Training Sites (NRTSs). Targeted workshops are a major component of MU-SPIN's approach.



MU-SPIN's working ICRE model functions as a virtual institute by:

- Performing collaborative research in NASA-related activities
- Including a minimum of two HBCUs or OMUs
- Assisting in coordination and providing content to a minimum of two NRTS academic-year workshops on NASA collaborative science and technology

MU-SPIN's NRTS/ICRE partnership focuses on:

- Continuing telecommunications technology support to the underserved
- Increasing NASA participation by facilitating new affiliations
- Delivering curriculum content through new activities with NASA partners
- Improving project relevancy through new NRTS and ICRE activities

## Workshops

MU-SPIN requires each NRTS to hold spring and fall workshops. These workshops range from implementing and using computer networking to writing competitive research proposals. Through the NRTS/ICRE partnership, funding requirements are identified for new opportunities.

Each NRTS has a focus area in science or technology. The following multidisciplinary workshops in the focus areas foster collaboration between partners and increase participation in NASA programs.

### Campus Technology

- Cabling
- Routing
- Addressing
- Distance Learning

### Education Methods

- Innovation
- Content

### Education Technology

- On-line Curriculum
- Asynchronous Communications
- Cache Servers
- Digital Libraries

### Proposal Development

- Writing
- Announcement Evaluation
- Team Building

### Science Curriculum Content

- Data Access
- Skills Development
- Student Learning Styles
- Data Visualization

### Earth and Space Sciences Research

- Science Themes and Objectives
- Current NASA Missions
- Announcement Evaluation
- Latest Developments

## NASA Opportunities for Visionary Academics

Morgan State University (MSU) and MU-SPIN are partnering to support the MU-SPIN schools that comprise over half of the nearly 80 member institutions in the NASA Opportunities for Visionary Academics (NOVA) program. NASA created NOVA to develop and disseminate a national framework for enhancing literacy in science, mathematics and technology for pre-service teachers in the 21<sup>st</sup> century. NOVA invites the participation of science, engineering, technology, mathematics, and education faculty who are concerned with how universities prepare new teachers. Using the NASA mission, facilities, and resources, NOVA provides faculty with enhanced knowledge and skills to implement change in university courses.



NOVA Workshop





Earth Science



Human Exploration  
and Development  
of Space



Space Science



Biological and  
Physical Research



Aerospace Technology

## NASA's Strategic Enterprises

NASA's program, as outlined in the Agency's Strategic Plan, comprises five strategic enterprises. Each enterprise covers a major area of the Agency's research and development efforts.

### Aerospace Technology:

To pioneer the identification, development, verification, transfer, application, and commercialization of high-payoff aeronautics and space transportation technologies.

### Biological and Physical Research:

To conduct basic and applied research to support human exploration of space and to take advantage of the space environment as a laboratory for scientific, technological, and commercial research.

### Earth Science:

To use the unique vantage point of space to gain information about Earth's environment that is obtainable in no other way. In concert with research and industry partners, the Enterprise is developing the understanding needed to support the complex environmental policy and economic decisions that lie ahead.

### Human Exploration and Development of Space:

To open the space frontier by exploring, using, and enabling the development of space and to expand the human experience into the far reaches of space.

### Space Science:

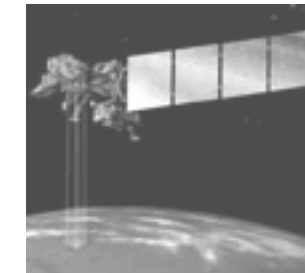
To solve mysteries of the universe, explore the solar system, discover planets around other stars, search for life beyond Earth from origins to destiny, chart the evolution of the universe, and understand its galaxies, stars, planets, and life.



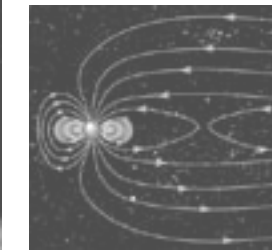
Hubble Space  
Telescope



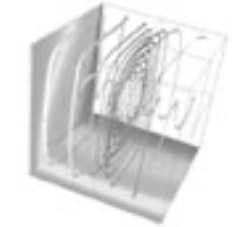
Mercury



Landsat



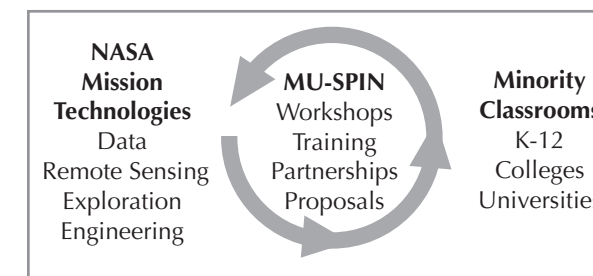
Earth's Magnetic  
Field



Fluid Motion  
under  
Microgravity

## Highlights from MU-SPIN Collaborations

MU-SPIN advances minority scholastic programs to benefit NASA's mission.



By exposing minority students to actual NASA science projects, MUSPIN engages them in science and mathematics and inspires them to pursue research careers in science and technology.

MU-SPIN approaches this in two ways. The first is by bringing NASA science into the classroom. The second is by increasing opportunities for minority students to participate in and contribute to NASA research. Both approaches offer students opportunities to experience the excitement of science and to develop the communication and writing skills necessary to succeed in their academic and professional careers.

## Biological and Physical Research

### Astrobiology Collaboration

Tennessee State University (TSU) and other minority universities are forming a collaboration to improve research opportunities, education, and outreach for minority institutions in astrobiology. The multidisciplinary nature of this important scientific field is ideal for developing a collaborative group to encourage national and international partnerships with minority institutions.

### Drop Tower Experiments

A drop tower facility was designed and developed at Florida International University (FIU) to allow free fall to simulate the microgravity conditions of space. This will be used to test fluoropolymer combustion and thermodegradation. Fluoropolymers are widely used on board spacecraft due to their excellent mechanical, electrical, and chemical-resistance properties. The goal is to provide a scientific basis for spacecraft fire safety policy.

### Microgravity Crystallization

Undergraduate minority students at Elizabeth City State University (ECSU) are collaborating

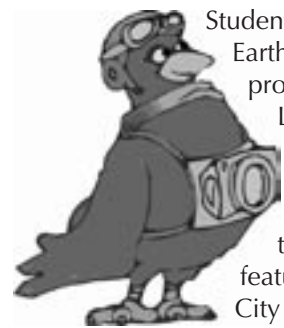
with researchers at the University of Alabama at Birmingham's Center for Biophysical Sciences and Engineering to learn state-of-the-art biotechnology techniques. Researchers at the Center are working to find proteins that could be candidates for potential drug treatments for stomach disorders ranging from gastritis to gastric cancer.

This project is collaborating with NASA scientists to send the proteins into space. The microgravity environment of space often yields larger and higher quality crystals than those grown under Earth's gravity. Students will use x-ray crystallography to compare the structure of the space and Earth grown crystals. This detailed structural knowledge could then lead to new drug development.

Earth Science

Amelia the Pigeon

"The Adventures of Amelia the Pigeon" is the story of a city and its history, as told from the point of view of a wayward pigeon traversing the history of land imaging. The adventure is based in New York City because minority inner city students can easily identify with images that relate to life in a big city.



Amelia

Students are introduced to Earth science by interpreting prominent features found in Landsat 7 satellite imagery. Students learn to classify the shape, color, and texture of objects, and to identify land and water features. TSU, MSU, and City University of New York (CUNY) are collaborating on development and testing.

The interactive website engages the students by using a game-like environment. Animated graphics illustrate the complex science concepts of remote sensing, while the addition of audio, video and animation enables young readers to directly experience remote sensing science.

Earth System Science Education Alliance

The Institute for Global Environmental Strategies and the Center for Educational Technology at Wheeling Jesuit University have partnered to offer on-line graduate courses for K-12 Earth System Science curriculum. Master teachers and Earth System scientists mentor educators during the 16-week program.

Echo the Bat

Scientists use Landsat imagery to help study and preserve our Earth's habitats. Preserving habitats and the routes between them are important to the survival of migrating species such as the Big Brown Bat. Bats play a critical role in the ecology of our planet, helping to control insects, pollinate flowers and disperse seeds.

"The Adventure of Echo the Bat" is a story about a baby bat migrating through the varied habitats of Arizona. It introduces remote sensing to our youngest future scientists. The book and related website tell the story of Echo to grades K-4.

Landsat images of the five habitats Echo travels through provide a backdrop for the adventure. Children can lift flaps on many of the landsat images to reveal



Echo

the land feature photograph underneath, showing them the landscape as Echo would see it.

The accompanying web site has a set of activities to reinforce four basic themes or concepts fundamental to the interpretation of satellite imagery—perspective, shape and pattern, color, and texture.

Geographic Information Systems

University of Texas at El Paso (UTEP) partners with the Center for Spatial Analysis and Remote Sensing at California State University-Los Angeles to conduct courses on the Geographic Information System (GIS). These courses give student re-



Northern Spotted Owl

searchers access to state-of-the-art GIS services, from data collection to database development and analysis. The Hoopa Valley Indian Reservation in northern California uses this project to manage timber, save spotted owl habitats, and clean up pollution.

GLOBE

MU-SPIN has partnered with the Global Learning and Observations to Benefit the Environment (GLOBE) program to bring science into minority classrooms. GLOBE is a highly successful, worldwide, interactive science program that offers students an opportunity to develop skills in soil, atmosphere, water, and ice sciences. To participate in GLOBE, teachers must attend a workshop to learn the GLOBE science measurement protocols and education activities. To date, two joint workshops have been held, one at Howard University and the other at Northern Arizona University. Participating in these workshops can increase the competitiveness of MU-SPIN minority partner institutions in Earth science education and research proposals. One MU-SPIN partner, Stone Child College, has already benefited from these workshops and won a NASA Education Award.



Joint MU-SPIN/GLOBE Tribal College Workshop

History of Winter

History of Winter is a professional development program for high school teachers. Science teachers from Maine to West Virginia collaborate with NASA scientists to understand the annual history of winter, which can be learned by studying the many different types of snow and ice. A goal of the

program is to prepare them to train other teachers in the scientific method.

The first critical step is to identify the snowflake properties of the east coast storms and discover the latitude variation. One team, the Snowflake Team, collects snowflakes and identifies the types of crystal formations. This data is used to compare atmospheric conditions for different storms and describe the type of snow for each of the storms.



Camping Out on Lake Placid

Teachers on the second team, the Snow and Ice Team, spend a week at Lake Placid, New York, to expand the study by characterizing ground snow and lake ice. They attend lectures, collect ice samples from Cascade Lake, and snow samples from a snow pit for their study.

Marine Biotechnology

Students from Baltimore's Southern High School are participating in bioscience research with microbiologists from the Center of Marine biotechnology, University of Maryland Baltimore Institute. Located at Baltimore's Columbus Center, the microbiologists interact with the students remotely through computers and internet access provided by MU-SPIN through MSU.

METropolitan Network

To support research and education in urban science, CUNY's Weather Project created METNET (METropolitan NETwork), a MU-SPIN funded network of weather stations at over 30 high schools and colleges in New York's metropolitan area. METNET helps stimulate Earth science education by providing students and teachers the opportunity to integrate weather research into the basic Earth science curriculum. The project works in cooperation with the New York City Mayor's Office for



Emergency Management and the National Weather Service to study the microclimates of the New York City metropolitan area.

Students are not the only ones benefiting from this program. METNET students collected and graphed the first highly detailed datasets on local weather features in the New York metropolitan area. Today researchers and others use the datasets in combination with other standard weather data sources such as surface and upper air maps, radar scans and satellite images to study long-term weather trends. The project includes installation and maintenance of weather stations, teacher-training workshops, and a summer program for teachers and high school students.



**METNET Students**

METNET has recently installed webcams at the three Native American schools that make up the Maine Indian Education School System. This addition offers students the opportunity to expand their studies to include comparison of urban and rural weather data.

**Ocean and Marine Science**  
The purpose of ECSU's Ocean and Marine Science Education and Research project is to encourage HBCU students to choose careers in these sciences. It is the intent of this project to develop an innovative and relevant research collaboration focused on coastal, ocean, and marine research.

The project involves the design of an academic year research project. Students have the opportunities to do research in the following areas: Advanced Very High Resolution Radiometer (AVHRR) Sea Surface Temperature (SST)/Sea Turtle Correlation, Phytoplankton Gear Comparison, and Fisheries Stock Assessment. ECSU students are actively involved in processing and analyzing the data and posting the results.

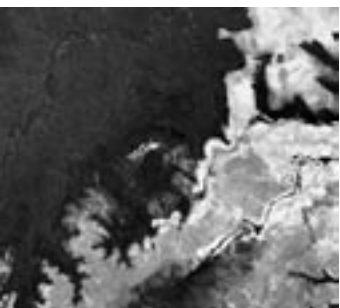
ECSU has acquired a SeaSpace TeraScan ground station to gather data from satellites to assist students with research in ocean and marine science.

**Research Experience in Earth System Science**  
Norfolk State University (NSU) and NASA Langley Research Center (LaRC) have partnered to offer a six-week undergraduate course in the visualization and interpretation of satellite data. Known as the Research Experience in Earth System Science (RE-ESS), the program is available for science, mathematics, engineering, and technology undergraduate students.

Students are assigned to research projects in NASA's Earth Science Enterprise (ESE). Projects investigate global atmospheric water vapor, atmospheric aerosol and ozone concentrations, the Earth Radiation Budget and computer programming for enhanced data visualization. The students do research work in NSU's scientific visualization laboratories coupled with field trips to LaRC. At the end of the program, each student has an understanding of the Earth as a coupled system in which many interactions are critical to climate change; understands satellite data manipulation, image processing, and interpretations; and is capable of accessing satellite images via the Internet and making informed interpretations.

**Science in Bolivia**  
In a remote part of the Bolivian lowlands, in an area hundreds of kilometers from the closest town, NASA scientists have identified what they believe is a complex meteorite impact crater. Valuable to Earth science research, meteorite impact craters can answer fundamental questions about the origin of life on Earth, local and global climate change, and the biological and geological history of the Earth.

NASA is sponsoring a second expedition to the crater for further investigation and research. Joining this expedition remotely are a group of MU-SPIN middle and high school teachers. As members of the home research teams, the teachers are assigned to a particular scientist and perform tasks such as data compilation, data analysis, and preliminary



**Impact Crater**

report writing. The science areas being investigated are varied and include geophysical data, magnetism, biodiversity, cratering phenomenon, meteorology, and soils science. At the conclusion of their work on the project, the teachers are responsible for writing an article on "the teacher as scientist" for a science teacher magazine.

**Wetlands Research**  
In 1975, ECSU acquired 639 acres of land in the Great Dismal Swamp from the US Department of Health, Education and Welfare. Because the property is surrounded by a large buffer zone of swamp, it is an unspoiled area well protected from the effects of human activities. The property is used by ECSU and other organizations to enable research of a pristine wetlands environment, as well as to promote public awareness of the crucial role played by wetlands in the coastal plain biome. Without the wetlands there would be no fishing industry in Albemarle or Pamlico Sounds.

- ECSU's Earth System Science Academy focuses on water quality and integrates environmental topics into hands-on learning activities that can be used in social studies, science, and mathematics studies. The Academy gives annual tours of the 1/2-mile-long boardwalk and observation tower.  
- Under the Mathematics of the Great Dismal Swamp Project, ECSU professors use swamp research to develop courses that incorporate wetlands applications. The project is sponsored by NASA's ESE, ECSU, and MU-SPIN.



**Great Dismal Swamp: Dying Trees**

**You be the Scientist with Satellite Imagery**  
The ECSU NRTS has targeted six middle schools located in economic Empowerment Zone and Enterprise Communities (EZ/ECs) in Virginia and North Carolina for this student enrichment program. The program is designed to support extracurricular Earth science activities, develop marketable skills in computer technology, and expose students to a variety of careers available in research, data analysis, applications, and computer visualization.

ECSU brings satellite imagery to these schools to enhance the study of mathematics and science by underrepresented minority students. The program is designed to aggressively strengthen the current Earth Systems Science (ESS) outreach to EZ/EC middle schools by the ECSU NRTS and NASA Goddard Space Flight Center (GSFC).

## Human Exploration and Development of Space

**Canutillo Rocket Program**  
The Canutillo Rocket Program, through the NRTS at UTEP, targets middle school students. Modules include constructing a simple altitude tracker and building water rockets to introduce the principles of flight and launch technology. An introduction to space-program careers explains the requirements for entering science-related fields.



**Canutillo Rocket**

## Space Science

**Astronomy Program at TSU**  
TSU supports research with faculty and students at the NASA University Research Center for Automated Space Science (CASS). MU-SPIN provides funding and staff for technical support.

CASS operates and is expanding the Fairborn Observatory located in the Patagonia Mountains of southern Arizona. Because the Fairborn telescopes are completely automated, observations are more flexible and cost less than non-automated

systems. Because of this remote capability, a CASS researcher in Tennessee was able to use the telescopes at Fairborn to provide the first direct and independent confirmation of the existence of extrasolar planets in 1999.

As a result of its programs, TSU has reactivated its astronomy curriculum and is now offering a minor in this discipline. These courses use NASA data and TSU's interactive electronic network to support research in astronomy and recruitment in technical fields. To introduce its successful astronomy program to other minority schools, TSU has developed on-line streaming video courses.

**CUNY Space Science Alliance**

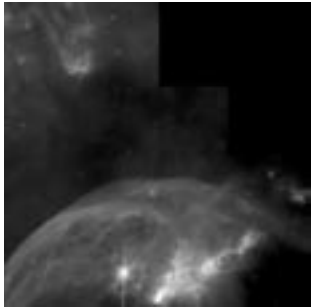
CUNY colleges have formed an alliance to offer a new degree in space science. Educators from CUNY, as well as educators from ECSU, South Carolina State University (SCSU), and Hampton University have been team teaching these courses. Students may take courses at any of the CUNY colleges towards this degree as well as a specially designed course offered at the Hayden Planetarium that introduces the Cosmos and targets the frontier of modern astrophysics.

**Hubble Image Analysis Workshop**

SCSU held its first annual Image Analysis Workshop for Minority University Faculty on its campus. One of the workshop objectives is to provide hands-on experience with astronomical image analysis and processing software applied to ground-based and Hubble Space Telescope (HST) imagery and spectra. The participants can then return to their home institutions and use the software techniques for research projects in astrophysics or related fields. The second objective is to explore possible collaborative research efforts with the intent of completing a detailed outline and timeline for writing and submitting a proposal to the Space Telescope Science Institute (STScI) for an archival project using HST data.

**NASA Space Science Projects**

MU-SPIN will be conducting education and outreach activities in collaboration with Johns Hopkins University/Applied Physics Laboratory (JHU/APL) to



*Bubble Nebula*

support three NASA projects - Mercury Surface, Space ENvironment, GEochemistry and Ranging (MESSENGER), Compact Reconnaissance Imaging Spectrometer for Mars (CRISM), and New Horizons. Projects for undergraduate students will highlight instrument technology and science. In the mission years, projects will concern pre-launch activities and testing, launch activities, and planetary science.

- MU-SPIN introduced its student intern program with the MESSENGER mission. An exciting first for MU-SPIN, interns are working alongside the lead engineers for MESSENGER to prepare for its upcoming 2004 launch. MESSENGER is intended to answer key scientific questions about Mercury. Mercury, our least explored terrestrial planet, is key to understanding the evolution of the inner solar system. The MUSPIN internship program will last throughout the mission, which is currently scheduled to end in 2011.

- CRISM is an instrument on the Mars Reconnaissance Orbiter, scheduled for launch in 2005. CRISM will search for mineral residue of water on the Martian surface.

- New Horizons is a spacecraft destined for the edge of our solar system. It will make the first reconnaissance of Pluto and Charon and then visit one or more Kuiper Belt Objects in the region beyond Neptune. The spacecraft will launch in 2006, fly by Pluto and Charon as early as 2015, and pass the Kuiper Belt Objects by 2026. Sending a spacecraft on this long journey will help answer basic questions about these bodies' surface properties, geology, interior makeup, and atmospheres.

**PVAMU's Solar Observatory Program**

With the acquisition of a telescope, Prairie View A&M University (PVAMU) was able to establish a solar physics program. Students learn to use solar observation instrumentation and receive education

related to solar observation and research. Included are the study of solar flares and prominences, and their relation to coronal mass ejections. Data gathered from the student studies has been archived in a solar observational data center.

There are three research components to the program. The first involves closely monitoring the most active solar regions for eruptions and flaring events. The second is the long-term evolutionary study of active regions. The third is the study of quiescent filaments, which are long, sheet-like prominences nearly vertical to the solar surface. Students make solar observations from sunrise to sunset, 7 days a week.

PVAMU plans to conduct a summer workshop, add a class on solar observations, host programs for local school teachers, and train graduate students. A partnership is being formed with The Laboratory for Astronomy and Solar Physics at GSFC to facilitate space-based research and student and faculty fellowships.



*PVAMU Telescope*

**Undergraduate Research Institute in Astrophysics**

SCSU conducts an 8-week residential course in astrophysics. The goal of the program is to motivate students to choose careers in the space sciences.

An introduction to astronomy includes an overview of the solar system; stellar, galactic, and extragalactic astronomy and cosmology; instrumentation; and the HST.

Students process astronomical images using image processing software. Additional experiences include observing sessions under a dark sky using telescopes, hands-on use of charge couple devices and computer interfaces, working sessions in the SCSU planetarium, and tours of observatories in Arizona and New Mexico.

**Virtual Telescopes in Education**

TSU is collaborating on the Virtual Telescopes in Education (VTIE ) project. VTIE is integrating telescopes used in the NASA-sponsored Telescopes In Education (TIE) project seamlessly into one virtual observatory.

TIE has been successful in engaging the K-12 education community in real-time, hands-on, interactive astronomy activities. Hundreds of schools in the US, Australia, Canada, England, and Japan remotely control the 24-inch telescope at the Mount Wilson Observatory from their classrooms.

VTIE will provide the services required to operate this facility, including a scheduling service, tools for data manipulation, and an online proposal review environment. TSU has been remotely controlling telescopes in Arizona for international astronomers for many years. They are also leaders in Quality of Service (QoS) technologies for transmitting large astronomy datasets from telescope sites.

**Interdisciplinary**

**3T Mentor Program**

The MSU NRTS implemented the National Technical Association's 3T Mentor Program - Technologists mentoring Teachers and Targeted students. 3T helps grades 4-12 students learn the skills necessary to pursue college and university courses in mathematics and science. 3T enables teachers to update their knowledge of disciplinary content, improve their science teaching skills, and interact with scientists, mathematicians, and engineers.

**Exploring Minds**

The Exploring Minds program, formerly Explorers of the Universe, is a scientific literacy project based at TSU. It is designed to stimulate student interest in Earth and space sciences from elementary through post-secondary schools. Through the Exploring Minds program, scientists at TSU and GSFC team with students at high schools across the country to participate in NASA and National Science Foundation-sponsored research. One such program,



known as the Mars Orbiter Laser Altimeter (MOLA) Education Program, is designed to involve students in the excitement of Mars exploration and to engage them in the scientific research process.

By utilizing the Exploring Minds web-based research management tools, teachers, university educators, community members, and practicing scientists help students learn the science research process. The program is being used as a pilot for courses at TSU and is being tested with the Amelia the Pigeon program with K-4 students in New York City.

**inet**

The UTEP inet workshop has become an international event. It draws over 300 teachers from around the world to learn web-based educational technology. inet is a two-day conference for faculty, staff, and administration in K-12 and higher education who are interested in the integration of technology into an educational environment.

**NASA Lecture Series**

To better prepare minority faculty and students to participate in NASA science, ECSU NRTS conducts a series of workshops called the NASA Lecture Series. The series brings the expertise and experience of scientists to a wide audience using both distance learning and live webcasting by using an innovative dual cast technology.

By bringing scientists and astronauts directly into the schools, the workshops build student interest for careers in NASA-related science, and encourage teachers to build science into their curricula. A special feedback mechanism has been set up to enable webcast participants to ask questions during the lectures.

**PVAMU Distance Learning**

Using MU-SPIN funding, PVAMU built a state-of-the-art distance learning network. The network allows PVAMU to deliver course materials to a wider Texas-wide audience. This technology facilitates MU-SPIN to provide new curriculum to minority institutions.

**Supercomputing Challenge**

The New Mexico High School Supercomputing Challenge uses the research tools of TSU's Exploring Minds program to manage over 100 team projects. In the Challenge program, teams of students and sponsoring teachers are paired with researchers to define and work on supercomputer projects.



*Exploring Minds Logo*

**Acronyms**

ALERT	Augmented Learning Environment and Renewable Teaching	NRTS	Network Resources and Training Site
AO	Announcement of Opportunity	NSIP	NASA Student Involvement Program
AVHRR	Advanced Very High Resolution Radiometer	NSU	Norfolk State University
CASS	Center for Automated Space Science	OMU	Other Minority University
CRISM	Compact Reconnaissance Imaging Spectrometer	PAIR	Partnership Awards for the Integration of Research
CUNY	City University of New York	PVAMU	Prairie View A&M University
ECSU	Elizabeth City State University	QoS	Quality of Service
ESE	Earth Science Enterprise	REESS	Research Experience in Earth System Science
ESS	Earth Systems Science	SCSU	South Carolina State University
EZ/EC	Empowerment Zone and Enterprise Community	SST	Sea Surface Temperature
FAR	Faculty Awards for Research	STAR	Scientific Technical and Academic Research Careers in MSET
FIU	Florida International University	STScI	Space Telescope Science Institute
GIS	Geographic Information System	TIE	Telescopes in Education
GLOBE	Global Learning and Observations to Benefit the Environment	TSU	Tennessee State University
GSFC	Goddard Space Flight Center	URC	University Research Centers
HBCU	Historically Black College and University	US	United States
HST	Hubble Space Telescope	UTEP	University of Texas at El Paso
ICRE	Institute for Collaborative Research and Education	VTIE	Virtual Telescopes in Education
JHU/APL	Johns Hopkins University/Applied Physics Laboratory		
LaRC	Langley Research Center		
MESSENGER	MErcury Surface, Space ENvironment, GEochemistry and Ranging		
METNET	METropolitan NETwork		
MOLA	Mars Orbiter Laser Altimeter		
MSET	Mathematics, Science, Engineering and Technology		
MSU	Morgan State University		
MU-SPIN	Minority University-SPace Interdisciplinary Network		
NASA	National Aeronautics and Space Administration		
NOVA	NASA Opportunities for Visionary Academics		
NRA	NASA Research Announcement		

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National Aeronautics and  
Space Administration

**Goddard Space Flight Center**